



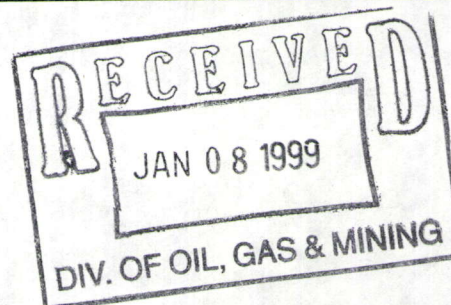
# Continental Lime Inc.

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January 8, 1999

Mr. Tom Munson  
Division of Oil Gas and Mining  
Minerals Reclamation Program  
1594 West North Temple, Suite 1210  
Box 145801  
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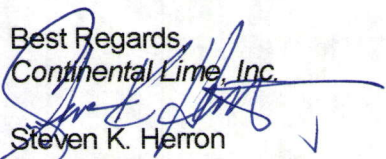
RE: Continental Lime, Inc. (CLI) Cricket Mountain Project (M/027/006) 1998 Poison Mountain Test Bench and Reference Transect Vegetation Data.

Dear Mr. Munson:

Attached, please find CLI's report to the Division of Oil, Gas & Mining (Division) concerning the results of the revegetation test program at CLI's Poison Mountain Quarry. The sampling was conducted in strict accordance with CLI's March 18, 1997 letter to the Division (SRK Letter, March 18, 1998; pg 3). Further, care was taken to comply with R647-106.7, so that the data collected would be in compliance with R647-4-111.13.11.

The data were collected, analyzed, and reported by REVEG Environmental (Lehi, UT). If you have any questions regarding this submission, please feel free to contact me anytime.

Best Regards,  
Continental Lime, Inc.

  
Steven K. Herron  
Geologist

Cc: Mike Brown—SLC  
Ian Chapman—SLC  
Stan Krukowski—SLC  
Joe Brokke—CM  
Bob Robison—CM  
Vic Kastner—CM



**General:** This report has been prepared by REVEG Environmental Consulting Inc. on behalf of Continental Lime Inc., Poison Mountain Quarry. Following a site visit by William Agnew (REVEG) with Steve Herron (Continental Lime) in June 1998, REVEG agreed to establish two reference areas, sample the reference areas for vegetation cover, and sample vegetation cover on reclaimed benches in the Poison Mountain Quarry.

Poison Mountain Quarry lies on the east slopes of the Cricket Mountains in Millard Co., Utah. The Cricket Mountains are typical of Great Basin mountain ranges with a north to south orientation. Vegetation is also typical of Eastern Great Basin desert mountains with wind swept ridges and Utah juniper fingering throughout the upper and mid slopes. In similar fashion, black sagebrush, dominates the shrub community on upper and mid slopes, particularly on north and east exposures. Blue bunch wheatgrass is the dominant upper to mid slope grass, usually associated with black sage. Because of the finer soils in the canyon valleys, basin big sagebrush is more abundant along with squirrel tail and needle-and-thread grass. Much of the lower slopes are dominated exclusively by cheatgrass, particularly where past fires have occurred.

#### A. Sampling Procedure

Sample sites consisted of eight quarry benches and two reference areas. Selection of reference areas was determined by evaluation of pre-quarry vegetation conditions. Based on pre-mining historic accounts and topographic maps provided by Continental Lime employees, Poison Mountain Quarry was originally an east facing limestone ridge with sparse vegetation. Though sparsely vegetated, plant employees remember the presence of Utah juniper (*Juniperus osteosperma*). Examination of pre-mining conditions on the east facing slope of the quarry reveal the presence of Utah Juniper along with the following dominant species: Cliffrose (*Purshia mexicana*), Broom Snakeweed (*Gutierrezia sarothrae*), and Bluebunch Wheatgrass (*Elymus spicatus*).

West of Poison Mountain Quarry (approx. 3/4 mile) lies an exposed and sparsely vegetated limestone ridge that was identified by Continental Lime as vegetated similarly to Poison Mountain Quarry. It possesses similar plant species, vegetation densities, exposed limestone, slope, and aspect. Since mining is scheduled to begin on that particular ridge, two similar ridges south of the ridge were selected as reference sites (see attached map).

Revegetated benches in the Poison Mountain Quarry were previously established as sampling sites by Continental Lime. A Total of eight benches were established prior to REVEG's study. Each of these benches was sampled by REVEG for vegetation cover to compare with previous estimates.

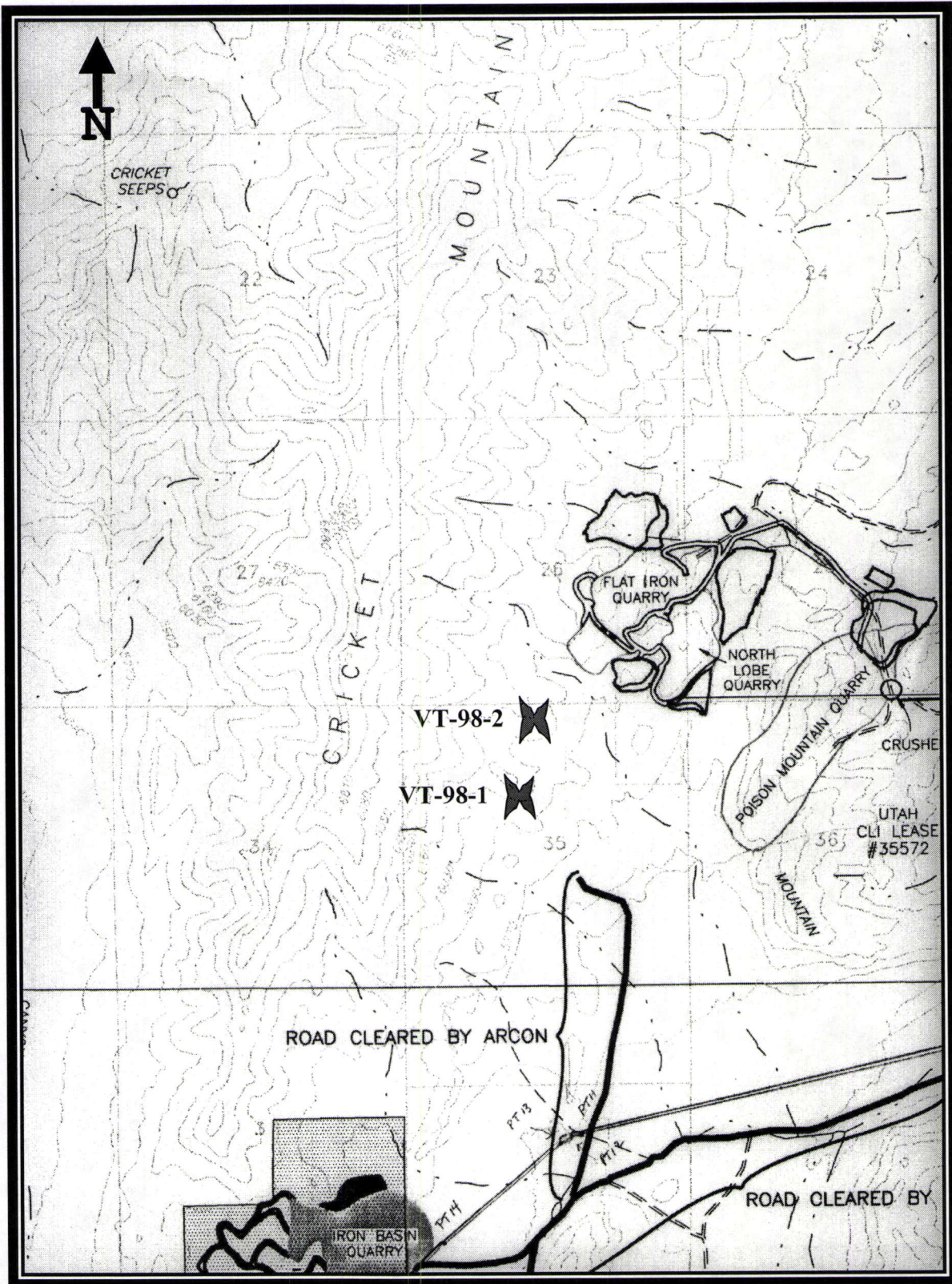
Vegetation cover and ground cover (bare ground, litter, rock, and gravel) were selected as the sample attributes with anecdotal species lists provided for each sample site. Site notes were recorded on any variable encountered that may influence vegetation abundance or physiognomy. Cover was recorded utilizing an optical point projection device mounted on a tripod. A cover value was recorded left and right of a 100 meter transect line. The sample interval was two meters, beginning at one meter on each transect line.

#### B. Reference Area

Two separate reference sites were sampled for vegetation cover and ground cover. Based on cover, the average of the two sites indicate that bluebunch wheatgrass is the most dominant species followed by cheatgrass, Utah juniper, black sagebrush, cliffrose, and broom snakeweed. Using the Bray-Curtis measure of dissimilarity, the two reference areas are more similar than dissimilar. An index value zero means



Figure 1: Reference sites in relation to mining operations.









communities are identical, and an index value of one indicates communities are completely different. Comparison of the two reference areas yielded an index value of 0.3627.

Transect lines for each reference site were placed on an axis perpendicular to the ridge slope. Such an orientation captured any subtle elevation gradients while maintaining the sample points within the designated community type. Individual reference site information is provided below.

1. Reference site VT-98-1: (transect azimuth=300°); Site is generally rocky, with sparse shrub and juniper. As revealed in ground cover estimates, approximately 56% of the surface was rock or gravel (gravel is defined as rock fragments less than one cm; fragments greater than one cm were classified as rock). There is a large litter component, but litter was extremely shallow and generally only under plant canopies. Soil cover is approximately 10%.

Table 1a.

Ground Cover	% Cover
Litter	33.0%
Rock	45.3%
Soil	9.7%
Plant Crown	1.0%
Gravel	11.0%

Cheatgrass provided more cover individually than any other species, but both Utah juniper, and bluebunch wheatgrass were near equal in cover values. Few forb species were in enough abundance to be recorded by cover, though collectively; many forb species were identified in the sample area (see table 1d.). Collectively, the woody species dominated the site at 22% cover, accounting for 57% of all vegetation sampled at this site. Native grasses account for 21% of all vegetation, identical to cheatgrass cover contribution. Since no exotic trees or shrub occur in the study area, only native shrub/tree cover is listed in the tables.

Table 1b.

Vegetation Cover by Species		Relative Cover	% Cover
Sandberg Bluegrass	<i>Poa secunda</i>	1%	0.3%
Gray's Lomatium	<i>Lomatium grayii</i>	1%	0.3%
Broom Snakebrush	<i>Gutierrezia sarothrae</i>	15%	4.3%
Cliffrose	<i>Purshia mexicana</i>	17%	5.0%
Black Sage	<i>Artemisia nova</i>	19%	5.7%
Utah Juniper	<i>Juniperus osteosperma</i>	24%	7.0%
Bluebunch Wheatgrass	<i>Pseudoregneria spicata</i>	26%	7.7%
Cheatgrass	<i>Bromus tectorum</i>	27%	8.0%
TOTAL			38%

Table 1c.

Vegetation Cover by Life Form	Relative Cover	% Cover
Forb – exotic	0%	0%
Forb – native	1%	0.3%
Grass – native	21%	8%
Grass – exotic	21%	8%
Tree/shrub (native)	57%	22%
TOTAL		38%

Native Cover = 30.3%



Species encountered in the sample area but not represented by cover values include:

Table 1d.

	Species	Common Name	Native vs. Exotic
1.	<i>Bromus rubens</i>	Red Brome	exotic grass
2.	<i>Hilaria jamesii</i>	Galleta Grass	native grass
3.	<i>Oryzopsis hymenoides</i>	Indian Rice Grass	native grass
4.	<i>Stipa comata</i>	Needle and Thread Grass	native grass
5.	<i>Haplopappus acaulis</i>	Stemless Golden-weed	native forb
6.	<i>Lomatium grayii</i>	Gray's Lomatium	native forb
7.	<i>Perityle stansburyi</i>	Stanbury's Rockdaisy	native forb
8.	<i>Phlox austromontana</i>	Desert Phlox	native forb
9.	<i>Echinocereus triglochidiatus</i>	Claret Cup	native shrub (cactus)
10.	<i>Ephedra nevadensis</i>	Nevada Ephedra	native shrub
11.	<i>Opuntia polyacantha</i>	Central Pricklypear	native shrub (cactus)
12.	<i>Petrophytum caespitosum</i>	Rock Spirea	native shrub

- Reference site VT-98-2: (transect azimuth=302°); General characteristics of this reference site is comparable to VT-98-1 with abundant exposed limestone, sparse juniper, bluebunch wheatgrass, and various shrubs. Rock and gravel cover is slightly higher at 63% with a correlated decrease in overall litter cover (22%). Soil cover is similar to the other reference point at 14%. Three additional species were encountered on the transect line. One obvious difference between the two reference points is a decrease in cheatgrass cover and an increase in bluebunch wheatgrass cover in plot VT-98-2.

Table 2a.

Ground Cover	% Cover
Plant	0.3%
Soil	14.3%
Gravel	19.0%
Litter	22.3%
Rock	44.0%

Table 2b.

Vegetation Cover by Species		Relative Cover	% Cover
Galleta	<i>Hilaria jamesii</i>	1%	0.3%
Purple Three-awn	<i>Aristida purpurea</i>	1%	0.3%
Gray's Lomatium	<i>Lomatium grayii</i>	1%	0.3%
Munro Globemallow	<i>Sphaeralcea munroana</i>	1%	0.3%
Needle and Thread Grass	<i>Stipa comata</i>	3%	1.0%
Utah Juniper	<i>Juniperus osteosperma</i>	6%	1.7%
Black Sage	<i>Artemisia nova</i>	8%	2.3%
Cliffrose	<i>Purshia mexicana</i>	9%	2.7%
Broom Snakebrush	<i>Gutierrezia sarothrae</i>	10%	3.0%
Cheatgrass	<i>Bromus tectorum</i>	13%	4.0%
Bluebunch Wheatgrass	<i>Pseudoregneria spicata</i>	46%	13.7%
TOTAL			30%



Reference plot two (VT-98-2), when compared to reference plot one (VT-98-1) reveals a reversal in herbaceous importance by life form. Instead of tree/shrubs providing the dominant cover, native grasses provide the greatest cover at 15%, accounting for 52% of the vegetation cover at the site. Tree/shrubs are subdominant, accounting for 33% relative cover. No exotic forbs were recorded. Overall cover was 8% less in plot two, but it can probably be attributed to less cheatgrass.

Table 2c.

Vegetation Cover by Life Form	Relative Cover	% Cover
Forb - exotic	0%	0%
Forb - native	2%	0.7%
Grass - exotic	13%	4.0%
Tree/shrub native	33%	9.7%
Grass - native	52%	15.3%
<b>TOTAL</b>		<b>30%</b>

Native Cover = 25.7%

Other species encountered in sample area but not represented by cover values include:

Table 1d.

Species	Common Name	Native vs. Exotic
1. <i>Blepharidacne kingii</i>	King's Desert-grass	native grass
2. <i>Bromus rubens</i>	Red Brome	exotic grass
3. <i>Oryzopsis hymenoides</i>	Indian Ricegrass	native grass
4. <i>Poa secunda</i>	Sandberg Bluegrass	native grass
5. <i>Haplopappus acaulis</i>	Stemless Goldenweed	native forb
6. <i>Perityle stansburyi</i>	Stansbury's Rockdaisy	native forb
7. <i>Phlox austromontana</i>	Desert Phlox	native forb
8. <i>Echinocereus triglochidiatus</i>	Claret Cup	native shrub (cactus)
9. <i>Haplopappus watsonii</i>	Watson's Goldenbush	native shrub
10. <i>Opuntia polyacantha</i>	Central Pricklypear	native shrub (cactus)
11. <i>Petrophytum caespitosum</i>	Rock Spirea	native shrub

### C. Quarry Benches

During 1996, eight quarry benches were seeded with a mix of introduced grasses, forbs, and some native shrubs (Correspondence Dec. 1996). Seed and straw mulch were used on five benches during December 1996, with the remaining three benches seeded in April 1997. Benches seeded in December received an application of 20 lbs./acre seed with 50 lbs./acre (16-16-8) fertilizer. Benches planted in April, received, an application of 12 lbs./acre seed with 40-lbs./acre (16-16-8) fertilizer. Seed mix was as follows:

Table 3.

Common Name	Scientific Name	lbs. PLS/acre
Hycrest crested wheatgrass	<i>Agropyron desertorum</i>	1.44 lbs.
Luna Pubescent wheatgrass	<i>Elytrigia intermedia ssp. trichophorum</i>	2.88 lbs.
Bozoisky Russian wildrye	<i>Psathyrostachys juncea</i>	2.88 lbs.
Forage Kochia	<i>Kochia prostrata</i>	0.48 lbs.
Yellow sweet clover	<i>Melilotus officinalis</i>	1.44 lbs.
Shadscale	<i>Atriplex confertifolia</i>	1.44 lbs.



Surface substrate of seven benches (5960 W, 5940 W, 5920 W, 5900 W, 5900 NW, 5900 E, 5940 E) was composed of limestone fines, and one bench (5940 NW) of a more suitable substrate (growth media material over limestone fines).

Dames & Moore sampled vegetation cover in March, May, and September, of 1997. REVEG Environmental re-sampled and analyzed vegetation cover during June/July of 1998. A total of 100 cover points were recorded per bench utilizing an optical point projection device. A 100 meter transect was allocated at the horizontal and vertical midpoint along each bench. Both canopy and ground cover was recorded. Data were organized as percent cover per species as well as grouping the species into characteristic life-form guilds. Total means of all cover-type groupings is also provided in the table below.

Table 4.

VEGETATION COVER BY LIFEFORM GUILDS		5900 E	5940 E	5900 W	5920 W	5940 W	5960 W	5900 NW	5940 NW	MEAN
Native grasses		0%	0%	0%	0%	0%	0%	0%	0%	0.0%
Introduced desirables grasses		3%	0%	3%	0%	1%	0%	2%	10%	2.4%
Introduced weedy grasses		0%	2%	1%	0%	0%	0%	0%	0%	0.4%
Native forbs		0%	0%	0%	0%	0%	0%	0%	0%	0.0%
Introduced desirable forbs		1%	1%	0%	0%	0%	0%	0%	3%	0.6%
Introduced weed forbs		0%	0%	0%	0%	0%	0%	0%	0%	0.0%
Native shrubs		0%	0%	1%	0%	0%	0%	0%	0%	0.1%
<b>TOTAL</b>		<b>4%</b>	<b>3%</b>	<b>5%</b>	<b>0%</b>	<b>1%</b>	<b>0%</b>	<b>2%</b>	<b>13%</b>	<b>3.5%</b>
MONTH SEEDED		DEC.	DEC.	DEC.	DEC.	APR.	APR.	DEC.	APR.	
<b>GROUND COVER</b>	Litter	0%	2%	0%	0%	0%	0%	0%	1%	0.4%
	Straw	47%	55%	5%	19%	1%	1%	8%	4%	17.5%
	Soil	0%	1%	0%	0%	0%	0%	0%	12%	1.6%
	Limestone fines	49%	37%	95%	73%	99%	99%	92%	36%	72.5%
	Rock	4%	5%	0%	8%	0%	0%	0%	47%	8.0%

On average, the 1996-97 seeding has yielded 3.5% cover. Introduced grasses are almost entirely responsible for the cover contribution.

Individual quarry bench vegetation cover analysis is provided below.

1. **Bench 5900 E:**

Vegetation Cover		Relative cover % Cover	
<i>Elytrigia intermedia ssp. trichophorum</i>	'Luna' Pubescent Wheatgrass	50%	1%
<i>Kochia prostrata</i>	Forage Kochia	25%	2%
<i>Agropyron desertorum</i>	'Hycrest' Crested Wheatgrass	25%	1%
<b>TOTAL</b>		<b>4%</b>	

**Species present but cover < 1%:** Four-wing Saltbrush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Cheatgrass (*Bromus tectorum*), and Yellow Sweet Clover (*Medicago officinalis*)

2. **Bench 5940 E:**

Vegetation Cover		Relative Cover % Cover	
<i>Bromus tectorum</i>	Cheat Grass	67%	2%
<i>Kochia prostrata</i>	Forage Kochia	33%	1%
<b>TOTAL</b>		<b>3%</b>	



**Species present but cover < 1%:** Four-wing Saltbrush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Yellow Sweet Clover (*Melilotus officinalis*), Prickly Lettuce (*Lactuca serriola*), Pubescent Wheatgrass (*Elytrigia intermedia ssp. trichophorum*), Crested Wheatgrass (*Agropyron desertorum*), and Russian Wild Rye (*Psathyrostachys juncea*).

3. Bench 5900 W:

Vegetation Cover		Relative Cover	% Cover
<i>Bromus tectorum</i>	Cheat Grass	20%	1%
<i>Agropyron desertorum</i>	'Hycrest' Crested Wheatgrass	20%	1%
<i>Atriplex canescens</i>	Fourwing Saltbrush	20%	1%
<i>Elytrigia intermedia ssp. trichophorum</i>	'Luna' Pubescent Wheatgrass	40%	2%
		<b>TOTAL</b>	<b>5%</b>

**Species present but cover < 1%:** Yellow Sweet Clover (*Melilotus officinalis*), Foxtail Barley (*Hordeum jubatum*), Halogeton (*Halogeton glomeratus*), Prickly Lettuce (*Lactuca serriola*).

4. Bench 5920 W:

Vegetation Cover		Relative Cover	% Cover
0 Cover Hits		<1%	<1%
		<b>TOTAL</b>	<b>&lt;1%</b>

**Species present but cover < 1%:** Four-wing Saltbrush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Yellow Sweet Clover (*Melilotus officinalis*), Pubescent Wheatgrass (*Elytrigia intermedia ssp. trichophorum*), Crested Wheatgrass (*Agropyron desertorum*), Forage Kochia (*Kochia prostrata*), and Oats (*Avena fatua*).

5. Bench 5940 W:

Vegetation Cover		Relative Cover	% Cover
<i>Elytrigia intermedia ssp. trichophorum</i>	'Luna' Pubescent Wheatgrass	100%	1%
		<b>TOTAL</b>	<b>1%</b>

**Species present but cover < 1%:** Four-wing Saltbrush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Flixweed (*Descurainia sophia*), Cheatgrass (*Bromus tectorum*), Halogeton (*Halogeton glomeratus*), Prickly Lettuce (*Lactuca serriola*), Crested Wheatgrass (*Agropyron desertorum*), and Russian Wild Rye (*Psathyrostachys juncea*).

6. Bench 5960 W:

Vegetation Cover		Relative Cover	% Cover
0 Cover Hits		<1%	<1%
		<b>TOTAL</b>	<b>&lt;1%</b>

**Species present but cover < 1%:** Shadscale (*Atriplex confertifolia*), Flixweed (*Descurainia sophia*), Pubescent Wheatgrass (*Elytrigia intermedia ssp. trichophorum*), Crested Wheatgrass (*Agropyron desertorum*), and Halogeton (*Halogeton glomeratus*).



7. **Bench 5900 NW:**

Vegetation Cover		Relative Cover	% Cover
<i>Elytrigia intermedia</i> ssp. <i>trichophorum</i>	'Luna' Pubescent Wheatgrass	100%	2%
		<b>TOTAL</b>	<b>2%</b>

**Species present but cover < 1%:** Shadscale (*Atriplex confertifolia*), Yellow Sweet Clover (*Melilotus officinalis*), Japanese Brome (*Bromus japonicus*), Halogeton (*Halogeton glomeratus*), Prickly Lettuce (*Lactuca serriola*), Crested Wheatgrass (*Agropyron desertorum*), Russian Wild Rye (*Psathyrostachys juncea*), Pubescent Wheatgrass (*Elytrigia intermedia* ssp. *trichophorum*), and Forage Kochia (*Kochia prostrata*).

8. **Bench 5940 NW:** This bench is the only bench utilizing select materials as a surface substrate. Actual soil cover measures 12%, nearly identical to the reference areas. Likewise, rock has about the same cover value at 47% cover. Performance of vegetation exceeds all other benches in abundance and size. Overall cover is 13%, of which 10% is attributable to grasses. Grass and forb cover is comparable to that measured in the reference areas, but the tree/shrub component is considerably lower. Tree/shrub cover is less than 1% compared to 8% cover on VT-98-1 and 9.7% tree/shrub cover on VT-98-2. Moderate grazing was apparent with grass foraging occurring prior to culm development, and only leaf blades from the rosettes were damaged.

Vegetation Cover		Relative Cover	% Cover
<i>Psathyrostachys juncea</i>	'Bozoisky' Russian Wildrye	8%	1%
<i>Agropyron desertorum</i>	'Hycres' Crested Wheatgrass	15%	2%
<i>Melilotus officinalis</i>	Yellow Sweet Clover	23%	3%
<i>Elytrigia intermedia</i> ssp. <i>trichophorum</i>	'Luna' Pubescent Wheatgrass	54%	7%
		<b>TOTAL</b>	<b>13%</b>

**Species present but cover < 1%:** Prickly Lettuce (*Lactuca serriola*), Forage Kochia (*Kochia prostrata*), Halogeton (*Halogeton glomeratus*), Russian Thistle (*Salsola pestifer*), Four-wing Saltbrush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Japanese Brome (*Bromus japonicus*), and Broom Snake Brush (*Gutierrezia sarothrae*).

D. **Discussion**

An average loss of 1.6% cover was determined since September of 1997 and is primarily due to bench 5940 NW, which during the September sampling period possessed a large (11%) cover of yellow sweet clover. Yellow sweet clover was at the seedling stage during REVEG's sampling period and would likewise have a large percent cover value if sampled during September. Cover values obtained in early spring (11.3%) are more similar to cover values obtained by REVEG (13%). Comparing May, 1997 cover values with 1998 reveals a loss of 0.77%. Though still depicting a loss of cover, much of the spring 1997 values are attributable to oat germination from the straw mulch. By 1998, most of the oat population has disappeared. The greater precision of the cover scope method used by REVEG may also have contributed to the overall cover disparity verses previous sampling techniques.

Difference between cover values on September 1997 and June/July 1998.							
<b>5900 E</b>	<b>5940 E</b>	<b>5900 W</b>	<b>5920 W</b>	<b>5940 W</b>	<b>5960 W</b>	<b>5900 NW</b>	<b>5940 NW</b>
-1.60%	-6%	+3%	0	+0.8%	0	+0.8%	-11.4%

Comparing the reference sites with the benches reveals a disparity between natural conditions and reclamation success. Bench 5940 NW is most similar, especially considering grass cover. Grass cover on bench 5940 NW = 10%, compared to the reference site's average grass cover at 17.65%. Excluding exotic



undesirable grasses, average native grass cover = 11.65% in the reference area. Both percent soil and rock cover are similar between the controls and this bench. Total average plant cover for both reference areas is 30%. Average "native" cover in the reference area = 28%. Since the reclamation goal is to obtain 50% of natural vegetation, the target cover value is 15%. If the goal is to reclaim the "native" portion of the natural plant community, then 14% is the target cover value.

Reference Areas	Mean % Cover	Target Cover Value
Total Vegetation	30%	15%
Native Vegetation	28%	14%